Composites/Compomers/Giomers

Layered Composite Resin Restorations (3/04)

Question: What is the difference between “shaded” and “anatomic” placement of composite resin restorations?

Answer: Newer composite resin systems are marketed with the capability of providing restorations that mimic the optical properties of natural teeth. Teeth are characterized by qualities other than just color.

Dentin is far more opaque and intensely saturated in color than enamel. Enamel features additional opalescent qualities. Properties such as translucency, opacity and opalescence are more difficult to determine objectively than color. Manufacturers now provide “dentin”, “enamel” and characterization materials with shades and levels of translucency that are coordinated with each other. Dentists can layer the composites to reproduce the shade, shape, and translucency of teeth in such a way to regain their original appearance.[1] The majority of anterior restorative cases are simple enough to be restored with one layer. However, in those cases where a higher level of esthetics is desired, such as larger Class IVs, diastema closures and direct veneers, a multi-layered process may be indicated. Layered techniques may be divided into “shaded” and “anatomic” placement.

The “shaded” technique has been available for several years and consists of the clinician determining the shade with a shade guide from the middle third of the tooth. The dentist then selects three corresponding composite resins to be placed in three successive layers. Typically, “dentin”, “enamel” and “translucent” composites all in the same shade are selected and placed. Many composite systems use this technique (e.g., Esthet-X, Dentsply/Caulk; Venus, Heraeus Kulzer). However, recently introduced systems now provide an “anatomic” technique in addition to the traditional “shaded” concept (e.g., 4 Seasons, Ivoclar Vivadent). “Anatomic” techniques are based on the layering process often used by dental laboratory technicians to create a restoration. In the “anatomic” technique, a highly chromatic “dentin” shade is matched to the existing dentin and a colorless “enamel” is then placed to replace the enamel layer. A final “translucent” layer may be added as necessary.[2]

Layered techniques can provide excellent esthetics in complex cases. Potential disadvantages of both techniques include a steeper learning curve, higher expense, and use of some shades not on the typical “Vita” shade guide.3

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Using VLC Composites Past Expiration (Originally published in May 1998)

Question: Can I use visible light-cured composite past the manufacturer's expiration date? The material still seems to set during light curing.

Answer: DIS does not feel at this time that an expired visible light-cured composite restorative material should be used for definitive restorations. Visible light-cured composites contain many components, all of which are crucial for the material's physical properties. Although an out-of-date material may appear satisfactory after light curing, there are no definitive tests to determine if all of the components are still optimal. For instance, if the silane coupling agent has deteriorated, a composite could suffer from a wear rate greater than what is normally expected. Dental manufacturers determine a material's expiration date consistent within known performance specifications and will not guarantee its performance past that date. **Material use beyond its expiration date for definitive restorations is completely the user's responsibility.** Hondrum has published research (General Dentistry, Jul-Aug 1997) detailing that one visible light-cured composite retained specific physical properties for up to seven years. Although this may be a step in the right direction for future research, **DIS recommends that the manufacturer's expiration date be observed until further research becomes available.** However, this is not to say that expired visible light-cured composite is completely worthless. Although not recommended for permanent restorations, other uses for expired composite may be considered. With some finesse, expired composite may be used to fabricate temporary crowns. Expired composite may also be used to repair margins on composite temporary crown materials. Bulk amounts of visible light-cured composite may also be used to stabilize matrix bands for complex amalgams. If you do utilize expired composite for the above uses, be certain to store it separately from your non-expired materials and have the container visibly marked annotating its condition and proposed uses.

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Packable Resin Composites as Amalgam Alternatives (Originally published in Sept 1999)

Question: I keep seeing more and more ads for condensible composites. Last week a salesman visited our clinic and said his product can be used as an amalgam alternative. What can you tell us about these products?

Answer: In the past few months, DIS has done quite a bit of testing of these products, and what we have learned is quite interesting. For review, because traditional resin composites used in the posterior dentition can be time-consuming and difficult to place, manufacturers have developed a subset of posterior resin composites that they describe as "condensible" or "packable." Most of the manufacturers indicate that they can be used in the posterior dentition as amalgam alternatives. Although initially, "condensible" was the term most commonly used to distinguish them from traditional resin composites, it is better to describe them as "packable" because no real condensation is being done during placement. Currently there are several packable resin composites on the market: SureFil (Dentsply/Caulk), ALERT (Jeneric/Pentron), Solitaire (Heraeus Kulzer), Prodigy Condensible (Kerr), Filtek P60 (3M), and Pyramid (Bisco). First marketed in 1998, they purportedly have several characteristics that make them esthetic alternatives to amalgam. First, their manufacturers claim they can be placed and packed into a preparation as if they were amalgam. In fact, they are still resins and handle like resins, but do resist packing to an extent because they are filled with either fiber (ALERT), porous (Solitaire), or irregularly-shaped (SureFil) filler particles, or different sizes of particles (Pyramid). In an attempt to make them appear to be similar to amalgam, some of the resins (e.g., ALERT, SureFil) are packaged in blister packs that differ by spill size. One product (SureFil) also comes with an amalgam carrier that the clinician uses to place it into the preparation. All the products can be packed with amalgam condensers and are used with traditional metal matrix bands and wooden wedges. Because they are more viscous and stiff than standard resin composites, it is a bit easier to achieve acceptable interproximal contacts with them than with traditional resin composites. Wear rates are supposedly similar to that of amalgam (about 3.5 microns/year), however, it should be noted that a study presented at a recent dental research meeting found a much higher wear rate for one of these products (Solitaire).

The manufacturers' claims notwithstanding, the packable resin composites exhibit properties that are quite similar to those of standard resin composites already on the market. For example, they are no harder, shrink about the same amount or slightly more, can not be carved, and must be incrementally placed and light activated. Also, they cost at least as much or more than many currently-available resin composites such as Z100 (3M), Spectrum TPH (Dentsply/Caulk), Prodigy (Kerr), and Herculite XRV (Kerr). Perhaps the most troubling claim made for these products by their manufacturers is that they can be placed in bulk (usually 5-mm thicknesses are cited) and light activated because they shrink less than other resins. It is important to note that none of these products can be adequately polymerized when placed in a 5-mm thickness. To their credit, Bisco and 3M do not recommend bulk placement for their products.

In summary, it doesn't appear that the packable resin composites present any great improvement compared to already-marketed resins for posterior use. Perhaps one of the few advantages they have is that it is easier to obtain an acceptable interproximal contact with them because they are stiffer and resist packing.

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Cross compatibility of Resin Composites and Dentin Bonding Agents

(Originally published in Jan 2000)

Question: Our clinic has the 3M ESPE's Scotchbond Multi-Purpose Adhesive Plus as our primary bonding product. Do we need to use 3M ESPE's composite resin with it or can we use another company's composite if we want to?

Answer: This is a question that I frequently receive at DIS and it is an important one. Quite commonly, representatives from dental product companies will encourage you to purchase their company's bonding agent **and** resin composite by claiming that the result will not be as good if you don't. In other words, they say that using their bonding agent with a competitor's resin composite (or vice versa) will produce an inferior result. The research, however, does not support this claim. No clear evidence exists that using a bonding agent from one manufacturer with a resin composite from a different manufacturer has an adverse effect on parameters such as microleakage[1] or bond strength.[2,3] Evidence does exist that appears to show a difference in bond strength between resin composites, which has led some researchers to recommend using the same manufacturer's resin composite and bonding agent.[4] The differences, however, may well be due to differences in strength between the types of resin composites[5,6] (eg, hybrids versus microfills) rather than a result of compatibility differences between bonding agents and resins. Likewise, a difference in microleakage found in one study was attributed to the resin composite type rather than brand.[1]

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Going with the Flow: Does it Make Sense? (Originally published in Jan 2003)

Question: Is it a good idea to use a flowable composite as a liner beneath a packable composite when I restore a posterior teeth?

Answer: It has become popular to routinely place a flowable composite (e.g., Filtek Flow, Flow-It ALC, Tetric Flow, Revolution Formula 2) on the pulpal floor and axial wall of a Class II preparation prior to restoring the tooth with a packable resin composite (e.g., Pyramid, SureFil, Solitaire 2, Prodigy Condensable).[1] In fact, some manufacturers of packable and flowable composites include recommendations in their instructions to do so. Clinicians usually place a flowable liner because it reduces the bulk of packable composite that has to be placed. This makes it easier and less time consuming to restore the tooth. Others believe it helps reduce leakage at the tooth/resin interface because the liner is flexible and absorbs some of the packable composite's shrinkage as it cures. This, at least theoretically, may result in a better bond between the resin and tooth with little or no gap being formed. There is some evidence supporting this theory.[2,3] Finally, some users place a flowable because it contains fluoride, and they believe that the fluoride release will have a anti-cariogenic effect.

If you routinely place a flowable composite as a liner before restoring a tooth with a resin composite, be it a microhybrid or packable, you should be aware of some precautions to take. First, the flowables are essentially "thinned down" composite resins, which accounts for their appealing characteristic of easy placement. The thinning down process is accomplished, at least in part, by incorporating fewer filler particles into the resin. As a result, physical properties such as strength and resistance to fracture are lower. So we should be mindful of the need to place a flowable in a relatively thin layer. Also, a study published a few years ago found that a number of then currently-available flowable composites lacked a sufficient degree of radiopacity.4 This means that on radiograph the flowable would appear as a thin, radiolucent line extending from the margin to the axial wall. Without a well-documented record, a clinician could misinterpret this as caries, possibly secondary to microleakage. Unfortunately, cases have been reported where the otherwise acceptable resin composite restoration has been removed only to find that the radiolucent "line" was a non-radiopaque flowable resin.

Perhaps the best reason for using a flowable resin as a liner beneath a packable composite is to make it easier to pack the composite into the preparation. Packables are thick, and it can be difficult to place them in a preparation (especially one that is irregular with undercuts) without producing voids. By placing a flowable resin liner into areas of the preparation that are difficult to access, the potential for producing voids is reduced.

The bottom line is not that we shouldn't use flowable resins as liners, but that we need to be aware of their limitations, so that we choose the right flowable product and use it sparingly so that its lesser physical properties do not compromise the clinical success of the packable resin restoration.

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Indications for Compomers (Originally published in Jan 2002)

Question: We have a compomer in our clinic but I just don't see where it is indicated for use. Are there special situations where they work better than other kinds of restorative materials?

Answer: Before we deal with the clinical indications for compomers, let's review a bit about what these materials are. Basically, compomers (also known as polyacid-modified resin composites) are fluoride-containing resin composites. DIS has evaluated a number of them. The first, Variglass VLC from the Dentsply/Caulk company, was marketed in the early 1990s and was advertised as a light-activated, multipurpose glass ionomer. Unfortunately, it didn't behave much like a true glass ionomer because it released very little fluoride and didn't set without being exposed to a curing light. If it had been a true glass ionomer or, even for that matter, a combination of resin and glass ionomer (like resin-modified glass ionomers such as Fuji II LC, Vitremer, and Photac-Fil), it would have hardened without light exposure. Despite their limitations, though, compomers have become popular because they handle like resin composites, are generally quite esthetic, and are marketed as having many of the advantages of true glass ionomers, including fluoride release and the ability to chemically bond to tooth structure. Of course, as is true of all dental materials, they have their shortcomings, such as a limited release of fluoride and the inability to be recharged with topically-applied fluoride.

As was mentioned earlier, the compomers remain very popular. The important question (and the one you asked) is: where are these products best indicated for use? Let's try to find a good clinical indication for them based on the types of cases we most commonly treat. The following is a simplification, but it will help us see where compomers may be indicated. Usually, we restore one of the following types of lesions:

- A carious lesion where esthetics is a concern
- A carious lesion where esthetics is not a concern
- A noncarious (e.g., abrasion, erosion, abfraction) lesion where esthetics is a concern
- A noncarious (e.g., abrasion, erosion, abfraction) lesion where esthetics is not a concern

So what types of restorative materials are best suited for these four clinical situations? The following table suggests a specific type of material and gives a rationale for using it in each kind of case.

Type of Lesion	Recommended Restorative	Reason for Choice
Carious; esthetics is a concern	Resin-modified glass ionomer	Provides acceptable esthetics with good fluoride release
Carious; esthetics is not a concern	Glass ionomer	Excellent fluoride release but not very esthetic
Noncarious; esthetics is a concern	Resin composite with current-generation bonding agent	Excellent esthetics with little, if any, fluoride release
Noncarious; esthetics is not a concern	Amalgam	Cost-effective and long-lasting; has no anti-caries effect

While not perfect and somewhat of an oversimplification, this table shows that there really is not a good clinical indication for compomers. Basically, what we see is that there are other materials that are better choices for most situations we encounter. Compomers remain popular, however, and will continue to be for many years. Various commercial brands of restorative glass ionomers, resin-modified glass ionomers, and compomers are given below.

Glass Ionomers	Resin-modified Glass Ionomer	Polyacid-modified Resin Composites (i.e., compomers)
Ketac-Fil (3M ESPE) Fuji II (GC America)	Fuji II LC (GC America) Vitremer (3M ESPE) Photac-Fil Quick (3M ESPE)	Dyract AP (Dentsply/Caulk) Hytac Aplitip (3M ESPE) Compoglass F (Ivoclar Vivadent) elan (SDS/Kerr) F2000 (3M ESPE)

Of course, as clinicians we choose the type and brand of restorative material we believe is best suited for each patient. The type of process we just went through, however, can be useful for determining what that material is, especially when faced with a myriad of choices.

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Giomer=Glass Ionomer + Composite (Originally published in Jan 2003)

Question: What is a giomer? Is it like a glass ionomer, and what is it used for?

Answer: Giomers are a relatively new type of restorative material. The name "giomer" is a hybrid of the words "glass ionomer" and "composite", which pretty well describes what a giomer is claimed to be. Although glass-ionomer restorative materials such as Ketac-Fil (3M ESPE) and Fuji Type II (GC America) have some very important properties, such as fluoride release, fluoride rechargeability, and chemical bonding to tooth structure, they also have well-known shortcomings. Their esthetics, for example, are less than ideal and make them a poor second choice to resin composites for restoring esthetically-demanding areas. Also, they are sensitive to moisture contamination and desiccation, which can present the clinician with challenges during their placement. In the 1990s manufacturers improved these shortcomings by adding resins to glass ionomers to produce resin-modified glass ionomers. These products (e.g., Fuji II LC, GC America; Vitremer, 3M ESPE; Photac-Fil Quick, 3M ESPE) have much better esthetics and handling characteristics than glass ionomers. Importantly, they also retain many of the glass ionomer's beneficial properties, such as long-term fluoride release and the ability to be recharged with topically-applied fluoride. They tend, however, to discolor over time. In another attempt to "better" the glass ionomer restorative materials, compomers were also developed. They were touted as being similar to glass ionomers but having much better esthetics and being easier to place and polish. Unfortunately, some of the manufacturer's claims were not confirmed by published research. Although they handled better than GICs, they released much less fluoride and could not be recharged.

In the continuing quest for improved glass ionomer-like restoratives, manufacturers have developed and introduced a new class of materials called "giomers." As noted earlier, the term implies they are combinations of glass ionomers and composites. Their manufacturers claim they have properties of both glass ionomers (fluoride release, fluoride recharge) and resin composites (excellent esthetics, easy polishability, biocompatibility). Giomers are distinguished by the fact that, while they are resin-based, they contain pre-reacted glass-ionomer (PRG) particles. The particles are made of fluorosilicate glass that has been reacted with polyacrylic acid prior to being incorporated into the resin. The pre-reaction can involved only the surface of the glass particles (called surface pre-reacted glass ionomer or S-PRG) or almost the entire particle (termed fully pre-reacted glass ionomer or F-PRG). Giomers are similar to compomers and resin composites in being light activated and requiring the use of a bonding agent to adhere to tooth structure. Only one giomer is commercially available at the time of this writing, Shofu's Beautiful, which uses the S-PRG technology. According to Shofu, Beautiful is indicated for restoring Class I through V lesions as well as for treating cervical erosion lesions and root caries. It is available in 13 shades and is supplied in syringes.

Little published research is available on the properties or performance of giomers. One recently published study compared the fluoride release of a glass ionomer, a resin-modified glass ionomer, a giomer, and a compomer. It found that while the giomer released fluoride, it did not have an initial "burst" type of release like glass ionomers, and its long-term (i.e., 28-day) release was lower than that of the other materials.[1] Another study found that a giomer, after polishing with Sof-Lex disks, had a smoother surface than a

glass ionomer, and one that was comparable to that of a compomer and a resin composite.[2] A three-year clinical study comparing the performance of a giomer with that of a microfill resin composite in Class V erosion/abrasion/abfraction lesions has also been done. After measuring eight performance characteristics, no significant differences between the two materials were found.[3]

Almost assuredly, many other giomer products will become available in the future. DIS will continue to assess the results of the published literature and perform evaluations of these products as they become available.

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"Soft-start" Polymerization of Resin-Composite Restorations (Updated Dec 2005)

Question: What can you tell me about "soft-start" polymerization?

Answer: "Soft-start" polymerization is a method recently advocated to reduce polymerization contraction stresses in resin-composite restorations. During early polymerization, the resin composite cross-linking network is relatively weak - allowing "flow" to fairly easily accommodate for stresses and prevent damage to adhesive bonds. With further polymerization, contraction and flow decrease, while stiffness and stress increase. This may cause adhesive failure. The bond strength must exceed the contraction stress to provide a stable marginal adaptation.[1] "Soft-start" polymerization proposes that a slower rate of conversion will allow better flow of resin with a decrease in contraction stress. "Soft-start" polymerization may be divided into three separate techniques: stepped, ramped, or pulse-delay. A stepped program emits a low irradiance for 10 seconds and then increases immediately to a maximum value for the duration of the exposure. In a ramped program, the irradiance gradually increases from a low value to maximum intensity over a 10-second period, after which it remains constant for the duration of the exposure. Pulse delay uses a short low-level burst, a delay for polishing, and finally a long exposure at full intensity. The majority of laboratory research suggests that "soft-start" polymerization may be beneficial,[2-17] but several studies have found no difference.[18-23] Also, the limited clinical trials available have shown no significant difference between the "soft-start" technique and conventional cure.[24,25] More in vivo research is desperately needed to substantiate the potential benefits of this concept.

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Resin - LED Curing Light Incompatibilities (Originally published in September 2003)

Question: I tried to cure a bonding agent with my new LED curing light and it failed to polymerize? What happened?

Answer: Light-emitting diode (LED) curing lights have a narrow spectral emission of light and may not polymerize all dental resin materials. Conventional halogen lights have a much wider emission spectrum and do not have this problem. The typical LED curing light produces light in a very narrow wavelength with peaks around 440 to 470 nanometers (nm), depending on the brand. This is ideal for the most common photoinitiator, camphoroquinone (CQ), which has an absorption peak around 468 nm, but is less effective for other photoinitiators that have peaks below 440 nm, such as phenyl-propanedione (PPD). Camphoroquinone is yellow in color. New photoinitiators were developed to provide less yellow intensity, especially for translucent shades. Fortunately there are only a few resin products that use other photoinitiators. Clinical Research Associates (CRA) recently published a listing of products that may not polymerize adequately with many LED curing lights. Not all available resin materials were tested, but the products identified so far were Biscover (Bisco, Schaumburg, IL); Cabrio (Discus Dental, Culver City, CA); Panavia F (Kuraray, New York, NY); Principle (Dentsply Caulk, Milford, DE); Pyramid, Neutral and Translucent (Bisco, Schaumburg, IL); and Touch and Bond (Parkell, Farmingdale, NY).[1] Some companies

have attempted to shift the emission spectrum of LED lights slightly to initiate multiple photoinitiators. However, a new LED light, Ultra-Lume LED 5 (Ultradent Products, South Jordan, UT), contains two different diodes with spectral-emission peaks near 400 and 450 nm. This allowed the new LED curing light to cure all the problematic materials listed above.

The potential advantages of the new LED curing lights were outlined in a previous DIS newsletter. Less power is necessary to operate LED curing units because of their unfiltered, narrow emission spectrum. Consequently they may be powered with rechargeable batteries, making them available in lightweight, cordless units. The diodes have a potential lifetime of several thousand hours instead of less than a hundred with halogen systems. Ninety-nine percent of the original energy emitted from a halogen light is useless energy that must be filtered out. Noisy fans are required to help eliminate this unwanted heat. LED units produce little wasted energy and require minimal cooling.

DIS is testing many new LED curing lights and the results will be continually reported. The first-generation LED lights suffered from low irradiance and high cost.[2,3] The second generation of LED curing lights have much higher irradiance and competitive government pricing. However, providers not using conventional halogen lights are advised to confirm the cure of their photo-initiated resin materials with their curing lights before they are used clinically.

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